

REMARKS

In response to the Office Action mailed August 15, 2005, Applicants respectfully request reconsideration. To further the prosecution of this Application, Applicants submit the following remarks, have canceled claims and have added new claims. The claims as now presented are believed to be in allowable condition.

Claims 1-9, 12-20, 22-27 and 30-35 were pending in this Application. By this Amendment, claims 24-27, 30, 32 and 34 have been canceled. Applicants expressly reserve the right to prosecute at least some of the canceled claims and similar claims in one or more related Applications. Accordingly, claims 1-9, 12-20, 22-23, 31, 33 and 35 are now pending in this Application. Claim 35 is an independent claim.

Preliminary Matters

Applicants wish to point out that the Patent Office did not process the IDS submitted by Applicants on July 27, 2004 a copy of which was enclosed in Applicants most-recent amendment with authorization to charge Applicants deposit account. Applicants again respectfully request that the Patent Office complete this IDS and return a completed PTO-1449 form with the next Patent Office communication.

Claim Objections

Claims 20 and 33 were objected to due to a few minor informalities. Applicants wish to thank Examiner Chace for point out these informalities and suggesting corrections. Applicants have made the corrections as outlined by Examiner Chace. Accordingly, the objection to claims 20 and 33 should now be withdrawn.

Drawings

The drawings were object to under 37 CFR1.83(a). In particular, the Patent Office contends that the drawings do not show every feature of the invention specified in claims 30, 31, 33 and 35.

Applicants respectfully traverse this objection. Every feature of the invention specified in claims 30, 31, 33 and 35 is shown in the drawings.

In connection with claim 30, Fig. 10 illustrates a data storage system 150 having a set of storage devices 100a, ..., 106, ..., 100n. Each storage device 100a, ..., 106, ..., 100n is configured to store and retrieve data in response to data access commands from a set of external host computers 140a, ..., 140n. The data storage system 150 includes first-tier RAID control circuitry 116 (Fig. 7) coupled to the set of storage devices 100a, ..., 106, ..., 100n. The first-tier RAID control circuitry 116 is configured to apply a first RAID scheme on the set of storage devices 100a, ..., 106, ..., 100n in a manner that treats the set of storage devices 100a, ..., 106, ..., 100n as a first array under application of the first RAID scheme. The data storage system 150 further includes second-tier RAID control circuitry 110 (Fig. 6) coupled to the array of storage devices 100a, ..., 106, ..., 100n. The second-tier RAID control circuitry 110 is configured to apply a second RAID scheme on a set of storage sub-devices 112a, 112b, ... of a storage device 106 of the set of storage devices 100a, ..., 106, ..., 100n in a manner that treats the set of storage sub-devices 112a, 112b, ... of that storage device 106 as a second array under application of the second RAID scheme.

Based on the above, the drawings clearly show a data storage system having a set of storage devices, as recited in claim 30. In particular, the drawings show that each storage device is configured to store and retrieve data in response to data access commands from a set of external host computers. The data storage system includes first-tier RAID control circuitry coupled to the set of storage devices. The first-tier RAID control circuitry is configured to apply a first RAID scheme on the set of storage devices in a manner that treats the set of storage devices as a first array under application of the first RAID scheme. The data storage system further includes second-tier RAID control circuitry coupled to the array of storage devices. The second-tier RAID control circuitry configured to apply a second RAID scheme on a set of storage sub-devices of a storage device of the set of storage devices in a manner that treats the set of storage sub-devices of that storage device as a second array under application of the second RAID scheme.

In connection with claim 31, Fig. 8 shows that the first-tier RAID control circuitry 114 and the second-tier RAID control circuitry 110 define a RAID hierarchy. Accordingly, the drawings clearly show that the first-tier RAID control circuitry and the second-tier RAID control circuitry define a RAID hierarchy, as recited in claim 31.

In connection with claim 33, Fig. 9 the controller 133, 134, 135 comprises a cache manager 134 configured to perform an operation selected from the group consisting essentially of: translate an address of a data storage device 112a, 112b, ... (Figs. 2-6) having a platter size of at least 3.5 inches in diameter to an address associated with the more than two disk drives, cache data associated with a received I/O request, load data from the data storage device having the platter size of at least 3.5 inches in diameter, and remove cached data from cache storage 132 associated with the controller 133, 134, 135. Accordingly, the drawings clearly show a controller as recited in claim 33.

In connection with claim 35, Fig. 10 clearly illustrates each storage device of the set of storage devices 100a, ..., 106, ..., 100n having at least one magnetic disk drive. A storage device 106 having a set of storage sub-devices 112a, 112b, ... includes, as the storage sub-devices 112a, 112b, ... , multiple small form factor magnetic disk drives. The first-tier RAID control circuitry 116 is adapted to treat each storage device of the set of storage devices 100a, ..., 106, ..., 100n as exactly one RAID device when applying the first RAID scheme to store particular data in the set of storage devices 100a, ..., 106, ..., 100n. The second-tier RAID control circuitry 110 is adapted to treat each storage sub-device of the set of storage sub-devices 112a, 112b, ... as exactly one RAID device when applying the second RAID scheme to store a portion of the particular data in the set of storage sub-devices 112a, 112b, ... in order to store the particular data in a RAID-within-RAID manner. Accordingly, the drawings clearly show a controller as recited in claim 35.

For the reasons stated above, the drawings clearly show every feature of the invention specified in the claims. As a result, the objection to the drawings under 37 CFR 1.83(a) should be withdrawn.

Rejection Under 35 USC 112, First Paragraph

Claim 35 was rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement. In particular, the Patent Office contends that the subject matter of claim 35 does not appear to be in the disclosure as originally filed, and accordingly appears to be new matter. Applicants respectfully traverse this rejection. The subject matter of claim 35 appears in the disclosure as originally filed as will now be explained.

Claim 35 recites a data storage system where each storage device of a set of storage devices has at least one magnetic disk drive. This feature of the invention is described in the Specification, for example, on page 12, lines 5-8 and Fig. 10.

Claim 35 further recites the storage device having the set of storage sub-devices includes, as the storage sub-devices, multiple small form factor magnetic disk drives. This feature of the invention is described in the Specification, for example, on page 12, lines 8-10 and Fig. 10.

Claim 35 further recites that the first-tier RAID control circuitry is adapted to treat each storage device of the set of storage devices as exactly one RAID device when applying the first RAID scheme to store particular data in the set of storage devices. This feature of the invention is described in the Specification, for example, on page 8, lines 20-25.

Claim 35 further recites the second-tier RAID control circuitry is adapted to treat each storage sub-device of the set of storage sub-devices as exactly one RAID device when applying the second RAID scheme to store a portion of the particular data in the set of storage sub-devices in order to store the particular data in a RAID-within-RAID manner. This feature of the invention is described in the Specification, for example, on page 8, lines 6-19.

For the reasons stated above, the subject matter of claim 35 appears in the disclosure as originally filed, and is NOT new matter. Accordingly, the rejection of claim 35 under 35 USC 112, first paragraph, must be withdrawn.

Rejection Under 35 USC 112, Second Paragraph

The Office Action rejected claims 30-31 and 33 under 35 USC, 112, second paragraph, as being indefinite. In particular, the Office Action contends that it is unclear how one can claim first and second tier RAID using common disks. Additionally, the Office Action asks whether the second-tier control circuitry is part of an array set. Furthermore, the Office Action asks contends that it is unclear what a storage sub-device is.

Applicants respectfully traverse this rejection. Claims 30-31 and 33 are definite and unambiguous.

First, one can clearly claim first and second tier RAID using common disks. Fig. 10 illustrates such a configuration where a first tier of disks is shown using reference numerals

100a, ..., 106c, ..., 100n, and a second tier of disk is shown within 106c. Moreover, Applicants do not know of any statute, rule or guideline prohibiting such a claiming.

Second, the Office Action appears to ask whether the second-tier control circuitry is part of an array set. Applicants have some difficulty in understanding this question. However, in an attempt to provide an answer, Applicants submit that the disks 112 of the device 106c form one RAID array, and the disks 112 (acting as a single storage device 106c) in combination with disks 100a, ..., 100n form another RAID array. Accordingly, the disks 112 and the controller 110 (Fig. 6) form an array.

Third, a storage sub-device is a small disk 112a, 112b, Clearly, if the device 106 containing the small disk 112a, 112b, ... is called a device within the Specification, a small disk 112a, 112b, ... of that device 106 can be referred to as a storage sub-device.

For the reasons stated above, claims 30-31 and 33 are definite and unambiguous. Accordingly, the rejection of claims 30-31 and 33 under 35 USC, 112, second paragraph, must be withdrawn.

Allowed Claims

Claim 35 was deemed allowable if rewritten in independent form and if the rejections under 35 USC 112, first and second paragraphs, are overcome. Applicants have rewritten claim 35 in independent form, and have overcome the rejections under 35 USC 112, first and second paragraphs. Accordingly, claim 35 is now in allowable condition.

Claims 1-9, 12-20, 22-23, 31 and 33 were amended to depend from claim 35 and to provide consistency. Accordingly, claims 1-9, 12-20, 22-23, 31 and 33 are now in allowable condition as well.

Conclusion

In view of the foregoing remarks, this Application should be in condition for allowance. A Notice to this affect is respectfully requested. If the Examiner believes, after this Amendment, that the Application is not in condition for allowance, the Examiner is respectfully requested to call the Applicants' Representative at the number below.

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Applicants hereby petition for any extension of time which is required to maintain the pendency of this case. If there is a fee occasioned by this Amendment, including an extension fee, that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 50-0901.

If the enclosed papers or fees are considered incomplete, the Patent Office is respectfully requested to contact the undersigned collect at (508) 366-9600, in Westborough, Massachusetts.

Respectfully submitted,



David E. Huang, Esq.
Attorney for Applicants
Registration No.: 39,229
CHAPIN & HUANG, L.L.C.
Westborough Office Park
1700 West Park Drive
Westborough, Massachusetts 01581
Telephone: (508) 366-9600
Facsimile: (508) 616-9805

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